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THE FLORA OF CANADA

by

J. M. Macoun and M. O. Malte

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Prickly pear (*Opuntia Rafinesquii*).

Photo by P. A. Taverner.

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Flora of Canada.[1]

BY J. M. MACOUN AND M. O. MALTE.

In order to understand the general characteristics of the Canadian flora as we see it to-day, and to make clear and explain certain features in the distribution of a number of species and genera, which at first may seem perplexing or even inexplicable, we must go back to the time when most of the Dominion was a vast glacial waste, destitute of plant life.

It is well known that the whole of Canada east of the Rocky Mountains was at a geologically recent period covered with glacial ice, which slowly advanced from the north and reached as far south as lat. 36°-37° in Eastern North America and lat. 46° on the Pacific coast. Evidences of general glaciation are also seen in the Rocky Mountains in the form of erratic boulders, carried there by the ice from the far north.

As the front of the continental glacier advanced southward, the plants in its vicinity, which naturally were of an arctic type, were driven slowly towards the south. At the same time the existing vegetation in front of the glacier, being unable to survive under arctic conditions, was also forced to move southward and to cede the ground to the invading arctic types. When the cold reached its maximum, those parts of the United States which now are temperate thus had a typical arctic flora, *i.e.*, a flora almost identical with the circumpolar flora of the present time. With the return of a warmer climate, the arctic plants gradually retreated northward, followed by more temperate and southern types. Generally speaking, the Canadian plants can therefore all be looked upon as immigrants gradually taking possession of the country after the glacial

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[1] Reprint from Canada Year Book, 1915, Census and Statistics Office, Ottawa, Canada, pp. 43-55.

period, the different species establishing themselves in regions where the climatic conditions met their specific requirements.

The glacial period, furthermore, explains readily a few striking features in the present distribution of Canadian plants, viz., the occurrence of identical species in localities separated by hundreds or even thousands of miles of land, across which, under present conditions, migration is impossible. Thus, a number of species occur in the Rocky Mountains which are identical with species living in Arctic Canada or in Labrador and Eastern Quebec, but occurring nowhere else in the Dominion. These facts may be explained in the words of Darwin, as follows:

> As the warmth returned (after the glaciation had reached its height) the arctic forms would retreat northward, closely followed up in their retreat by the productions of the more temperate regions. And as the snow melted from the bases of mountains, the arctic forms would seize on the cleared and thawed ground, always ascending higher and higher, as the warmth increased, whilst their brethren were pursuing their northern journey. Hence, when the warmth had fully returned, the same arctic species, which had lately lived in a body together in the lowlands . . ., would be left isolated on distant mountain summits (having been exterminated on all lesser heights) and in the arctic regions. . . .

With regard to British Columbia, a few words may be said in explanation of the diversity of the flora. Although glaciation may not, at any time, have been general, it is nevertheless highly probable that its flora, at the time of the glacial period, was subjected to the necessity of migration in a north and south direction. At any rate, the British Columbia flora is most closely related to the flora south of the province, genera and species occurring which extend as far south as to New Mexico and California.

The most characteristic feature of the flora of British Columbia is, however, not so much its general relationship to the flora to the south as the existence of different floristic provinces more or less sharply defined. The existence of different "floras" is due not only to the highly diversified climatic conditions, but perhaps still more to the presence of mountain chains and desert-like areas which act as barriers checking the free migration of the plants.

Arctic Zone.—Botannically, the Arctic Zone is the region lying north of the tree line. In Canada it extends far to the south of the Arctic circle, especially in the eastern parts of the Dominion. Its southern limit is, roughly, a line running from the estuary of the Mackenzie river to the mouth of the Churchill river, on the west coast of Hudson bay. East of Hudson bay, the tree line runs from about lat. 52° on Richmond gulf to the mouth of George river on the eastern shore of Ungava bay, and from there in a southeasterly direction along the coast of Labrador to Hamilton inlet.

The arctic flora of Canada is very closely related to that of Europe, especially the Scandinavian, a very great proportion of the arctic

Canadian plants being also common in Lapland and arctic Russia. A number of species occurring chiefly in the most western parts of arctic Canada are of Asiatic relationship, and very few are of American origin. Among these may be mentioned *Douglasia arctica*, *Cardamine digitata*, and *Pleuropogon Sabini*.

With regard to general characteristics, the arctic flora of Canada is quite similar to the arctic or "circumpolar" flora in general. It is composed almost exclusively of perennial plants, which exhibit those well known features with regard to biology and anatomical structure which the arctic flora has in common with the flora of high alpine regions. In the more northern parts, where the ground is physiologically more or less dry, or where it is rocky, the growth is often very compact and includes a great number of plants of the so-called "bunch type." Suffice it to mention *Silene acaulis*, *Papaver radicatum*, *Potentilla nivea*, *Saxifraga tricuspidata*, *S. oppositifolia*, *Armeria sibirica*, *Androsace Chamæjasme*, *Melandrium apetalum*, *Kobresia Bellardii*, *Carex rupestris*, *C. membranopacta*, *C. nardina*, *Poa glauca*, *Festuca ovina var. brevifolia*, *etc.* Similar growth is also encountered, though less commonly, on the tundra, *i.e.*, the more southerly and physiologically wetter part of the arctic region. Among the tundra plants of the bunch type may be mentioned: *Diapensia lapponica*, *Arenaria macrocarpa*, *A. arctica*. Compactness of growth is also displayed by a number of plants which, though not growing in "bunches" form dense and often very extensive mats. To this type belong *Cerastium alpinum*, *Ranunculus hyperboreus*, *Sibbaldia procumbens*, *Dryas integrifolia*, *Loiseleuria procumbens*, *Cassiope tetragona*, etc. Among the more conspicuous arctic herbaceous plants which grow neither in mats nor in bunches may be mentioned: *Dupontia Fischeri*, *Eriophorum Scheuchzeri*, *E. angustifolium*, *Spiranthes Romanzoffiana*, *Habenaria hyperborea*, *Oxyria digyna*, *Polygonum viviparum*, *Ranunculus nivalis*, *R. affinis*, *Parrya arctica*, *Eutrema Edwardsii*, *Saxifraga flagellaris*, *S. hieracifolia*, *Pyrola grandiflora*, *Primula sibirica*, *Pedicularis flammea*, *Arnica alpina*, *Saussurea alpina*, *Chrysanthemum integrifolium*.

As indicated above, the Arctic zone has no real trees. The woody plants, characteristic to the zone in general, are either prostrate forms, such as *Salix arctica* and its varieties, *S. orbicularis*, *S. anglorum*, or of a more shrubby appearance, such as *Betula nana*, *B. glandulosa*, and *Salix Richarsonii*. On the tundra, the woody plants are chiefly of the ericaceous family, the principal ones being *Ledum palustre*, *Rhododendron lapponicum*, *Vaccinium uliginosum*, *V. Oxycoccus*, *V. Vitis-Idæa var. pumilum*, *Arctostaphylos alpina*. The berries of the two latter species, with those of *Empetrum nigrum*, form the chief food of the migrating geese in the spring of the year.

Sub-arctic Forest Zone.—The sub-arctic or so called coniferous forest extends in the east from the Arctic zone southward to a line running from Anticosti to the southern end of Lake Winnipeg. This line is practically identical with the northern limits of the White and the Red Pine. West of Lake Winnipeg the sub-arctic forest is bounded to the south and west by the prairie and the foothills of the Rocky Mountains, respectively. The Gaspé peninsula and the greater part of New Brunswick may also be included in the sub-arctic forest.

As the name indicates, the sub-arctic forest is decidedly boreal. It is largely coniferous in character, the only deciduous trees occurring throughout the region being poplars and white birch. The sub-arctic forest is as yet almost undisturbed by settlers. It forms a vast reserve of national wealth, and is destined in the future to furnish the chief supply of timber for the pulp and paper industries of eastern North America, as Black and White Spruce (*Picea mariana* and *P. canadensis*) are dominant trees. Of the other coniferous trees, the Banksian Pine (*Pinus Banksiana*) is the most important. It reaches perfection in the western part of the zone, and constitutes the chief source of supply of lumber for the northern prairie region. The other trees characteristic of the zone in general are Aspen Poplar (*Populus tremuloides*), Balsam Poplar (*P. balsamifera*), White Birch (*Betula papyrifera*), Larch (*Larix laricina*) and Balsam Fir (*Abies balsamea*). Bewteen Lake Winnipeg and the Gulf of St. Lawrence, White Cedar (*Thuja occidentalis*), Elm (*Ulmus americana*) and Ash (*Fraxinus nigra*, *F. americana*) are occasionally met with, but cannot be considered characteristic of the sub-arctic forest.

On the whole, the sub-arctic forest covers a rolling country with numerous bogs and lakes in the depressions. Perhaps its most striking character is the abundance of berry shrubs, including Gooseberries (*Ribes oxyacanthoides*), Currants (*R. hudsonianum*, *R. triste*), Blueberries (*Vaccinium canadense*), Rock Cranberries (*V. Vitis-Idœa*), Raspberries (*Rubus strigosus*), Yellow-berries (*R. Chamœmorus*), High-bush Cranberries (*Viburnum Opulus*, *V. pauciflorum*)and others.

The vegetation of the bogs shows but little variation, and the species encountered in the bogs of one part of the zone are characteristic of practically the whole sub-arctic forest. A number of species occurring on the tundra further north reach perfection in the bogs of this zone. Among the leading bog plants may be mentioned: *Ledum groenlandicum*, *Kalmia polifolia*, *Andromeda glaucophylla*, *Habenaria hyperborea*, *Epipactis repens var. ophioides*, *Menyanthes trifoliata*, *Utricularia americana*, *Pedicularis groenlandica*, *Eriophorum* and *Carex* species.

On the whole, the flora of the sub-arctic forest is remarkably uniform throughout, and hardly a species is found that does not occur in the Arctic

zone or to the south. A noteworthy exception to this general rule is *Castalia tetragona*, the smallest of the water lilies, which in Canada is found in the sub-arctic forest only.

Hardwood Forest Zone.—The hardwood forest zone includes all eastern Canada south of the sub-arctic forest with the exception of a small region in southern Ontario, extending between the shore of Lake Erie and a line running approximately from Toronto to Windsor.

There is little cultivated land in Eastern Canada north of this zone. As its name indicates, it is characterized chiefly by deciduous trees, the principal ones being: Basswood (*Tilia americana*), Sugar Maple (*Acer Saccharum*) Red Maple (*Acer rubrum*), Black Ash (*Fraxinus nigra*), White Ash (*Fraxinus americana*), White Elm (*Ulmus americana*), Yellow Birch (*Betula lutea*), Red Oak (*Quercus rubra*), Burr Oak (*Quercus macrocarpa*), Beech (*Fagus grandifolia*). Of the coniferous trees, the White Pine (*Pinus Strobus*) the Red Pine (*P. resinosa*), the Hemlock (*Tsuga canadensis*), and the White Cedar (*Thuja occidentalis*), are the most important.

The underbrush, though very variable and made up of a great number of species, is generally rather scanty and becomes conspicuous—as a component of the forest—only along its borders or where the woods are very open. Among the most typical shrubs may be mentioned: Service Berry (*Amelanchier spicata*), Moosewood (*Dirca palustris*), Purple Flowering Raspberry (*Rubus odoratus*), Sumach (*Rhus typhina*), Poison Ivy (*Rhus Toxicodendron*), and Arrow-woods (*Viburnum alnifolium*, *V. acerifolium*, *V. cassinoides*).

As the rainfall is abundant throughout the hardwood forest zone, the herbaceous vegetation is rich, in both species and individuals, everywhere where light and soil conditions permit. In the woods proper it is rather insignificant after the foliage of the trees is fully developed. In the spring, however, it is very luxuriant, and especially where the soil is rich and deep there is a magnificent display of beautifully coloured and showy forms, for instance: Trillium (*Trillium grandiflorum*, *T. erectum*, *T. undulatum*), Bellwort (*Uvularia perfoliata*), Dog's-Tooth Violet (*Erythronium americanum*), Showy Orchis (*Orchis spectabilis*), Jack-in-the-Pulpit (*Arisæma triphyllum*), Spring Beauty (*Claytonia caroliniana*), Violets (*Viola*, blue, white, and yellow forms), Hepatica (*Hepatica triloba*, *H. acutiloba*), Dutchman's Breeches (*Dicentra Cucullaria*), Squirrel Corn (*Dicentra canadensis*), Bloodroot (*Sanguinaria canadensis*), Pepper-root (*Dentaria diphylla*), Barren Strawberry (*Waldsteinia fragarioides*), Flowering Winter-green (*Polygala paucifolia*), Blue Phlox (*Phlox divaricata*), etc. Others, less conspicuous, but characteristic of the hard-wood spring flora, are species of Sedges (*Carex*), Wild Ginger (*Asarum canadense*), Blue Cohosh (*Caulophyllum*

thalictroides), False Mitrewort (*Tiarella cordifolia*), Mitrewort (*Mitella diphylla*), Star Flower (*Trientalis americana*) and Showy Lady's Slipper (*Cypripedium hirsutum*).

During the summer the herbaceous vegetation is chiefly confined to borders of woods, clearings and other places where growth is not suppressed or kept back on account of too much shade. It is rather inconspicuous and poor except in moist or wet situations. On moist and low ground occur: *Habenaria psychodes, Gentiana crinita, Asclepias incarnata, Physostegia virginiana, Chelone glabra, Lobelia cardinalis, etc.*, whilst *Pogonia ophioglossoides, Calopogon pulchellus, Arethusa bulbosa, Sarracenia purpurea* and others adorn the bogs and swamps.

The autumn flowers are chiefly composites with Asters, Golden Rods (*Solidago*) and Joe-Pye (*Eupatorium*) in the greatest profusion.

Very characteristic of the zone is the autumnal colouring of the leaves of trees, shrubs and herbaceous plants. This autumnal colouring lasts a comparatively long time, from about the first week of September to the second week in October, dependent on the dryness of the season. During that period the most splendid display of colours is exhibited, especially in the open mixed woods where underbrush is well developed. Every shade of yellow, golden bronze, red and scarlet is mixed in a gorgeous symphony of colours, generally most marvellously modulated by the sombre deep dark or bluish green of the conifers, which are dotted among the deciduous trees. No such wealth of colour is ever met with in any other country.

Carolinian Zone.—This zone is confined to a small tract of land in southern Ontario, bounded to the south by Lake Erie and to the north by a line running approximately from the northern shore of Lake Ontario to Windsor. Its flora is most typically developed in the Niagara peninsula and on the very shore of Lake Erie. In general physiognomy it is rather similar to the hardwood forest flora just described, but differs greatly as far as characteristic species—and even genera—are concerned. It is decidedly southern as to species, and exhibits a large number of forms which occur nowhere else in Canada.

The most characteristic trees are the Hickories (six species), the Oaks (ten species), the Black Walnut (*Juglans nigra*), the Chestnut (*Castanea dentata*), and the Sycamore (*Platanus occidentalis*). Less abundant and more local in their distribution are: Cucumber tree, (*Magnolia acuminata*), Tulip tree (*Liriodendron Tulipifera*), Flowering Dogwood (*Cornus florida*), which have all beautiful and very conspicuous flowers, Papaw (*Asimia triloba*), Red Mulberry (*Morus rubra*), American Crab Apple (*Pyrus coronaria*), Sour Gum (*Nyssa sylvatica*), Sassafras (*Sassafras variifolium*) and others.

The herbaceous vegetation is very rich, at least a hundred species occurring nowhere else in Canada being found in the zone. A few of the most conspicuous may be mentioned, viz.: Yellow Nelumbo or "Lotus Flower" (*Nelumbo lutea*), May Apple (*Podophyllum peltatum*), Wild Lupine (*Lupinus perennis*), Tick Trefoil (*Desmodium*), Flowering Spurge (*Euphorbia corollata*), Swamp Rose Mallow (*Hibiscus Moscheutos*), Wild Pansy (*Viola Rafinesquii*), Prickly Pear (*Opuntia Rafinesquii*), Poke Milkweed (*Asclepias phytolaccoides*), Wild Potato Vine (*Ipomoea pandurata*), Downy Phlox (*Phlox pilosa*), Waterleaf (*Hydrophyllum appendiculatum*), Bee Balm (*Monarda didyma*), Foxglove (*Gerardia pedicularia, G. virginica*), Tall Bellflower (*Campanula americana*), Great Lobelia (*Lobelia siphilitica*), Ironweed (*Vernonia altissima, V. illinoensis*), Dense Button Snakeroot (*Liatris spicata*), Prairie Dock (*Silphium terebinthinaceum*), Cup Plant (*Silphium perfoliatum*), Sunflower (*Helianthus decapetalus, H. divaricatus*), Tall Coreopsis (*Coreopsis tripteris*), Indian Plantain (*Cacalia tuberosa*). Golden Seal (*Hydrastis canadensis*) and Ginseng (*Panax quinquefolium*) were at one time abundant but are now practically extinct.

The Prairie.—Under the general term prairie is understood the vast grass-covered area of the provinces of Manitoba, Saskatchewan and Alberta. It is bounded in the east and north by the sub-arctic forest and in the west by the foothills of the Rocky Mountains.

The prairie which begins a few miles east of Winnipeg had been subdivided into three zones, known as the first, second and third "Prairie Steppes."

First Prairie Steppe.—This, as defined by Professor John Macoun, includes "the low plain of Manitoba, bounded by a line of elevated country, which commences at the international boundary, at a point some distance west of Emerson, and extends northwestwardly under the names of Pembina, Riding, Duck, Porcupine and Pas mountains."

The southeastern part of the area so defined differs from the true prairie in that it is characterized by many woodland plants which have their home east of the Great Lakes, but occur rarely, if at all, between Lake Huron and the Manitoba border, for instance, Nettle Tree (*Celtis occidentalis*), Basswood (*Tilia americana*), Wild Plum (*Prunus americana*), Hawthorn (*Cratægus* species), Virginia Creeper (*Psedera quinquefolia*), Climbing Bitter-Sweet (*Celastrus scandens*), Wild Grape (*Vitis vulpina*), Moonseed (*Menispermum canadense*), Bloodroot (*Sanguinaria canadensis*), Columbine (*Aquilegia canadensis*), Hog Peanut (*Amphicarpa monoica*), Tick Trefoil (*Desmodium canadense*), "Prickly Cucumber" (*Echinocystis lobata*), Gentian (*Gentiana procera*), Lousewort (*Pedicularis canadensis*), Indian Paint Brush (*Castilleja coccinea*), Ox-eye (*Heliopsis scabra*), Cone-flower (*Rudbeckia laciniata*), etc.

The prairie proper of the first prairie steppe is confined chiefly to what is known as the "Red River Valley," *i.e.*, the low flat plains south and west of Winnipeg. In this region trees are met with only as forming narrow fringes along the rivers. Elm (*Ulmus americana*), Oak (*Quercus macrocarpa*), Poplar (*Populus tremuloides*, *P. balsamifera*), Ashleaved Maple (*Acer Negundo*) are the most abundant. Away from the immediate borders of the streams the prairie is treeless. It is covered with an abundance of herbaceous plants, growing in the greatest profusion. The most widely represented families are *Compositæ*, *Rosaceæ*, *Leguminosæ*, *Gramineæ*, and *Cyperaceæ*, but the species representing them cannot be said to be characteristic of the zone, as practically all of them are found in suitable localities further west.

Second Prairie Steppe.—This extends westward to a line running approximately from the international boundary at long. 103°-30′ in a northwesterly direction to Battleford. The flora of this zone is rather diversified, and several very different types of plant associations are met with.

In the north, where the prairie and sub-arctic forest meet, the flora is composed of species characteristic of both zones. This is also true of the northern part of the third prairie steppe.

In the southwestern part of the zone, *i.e.*, the country southwest of Moose mountains in Saskatchewan, the vegetation is in many respects closely related to that of the dry belt of the third prairie steppe. The grass is very short and the vegetation in general decidedly xerophile in character. In places, large sandy tracts exist which are covered with a profusion of cactus (*Mamillaria vivipara*), and in others there is no vegetation except that peculiar to arid soil.

Extending from the bases of the hills forming the boundary between the first and second prairie steppes there is much broken or parklike country. This is also met with in the Qu'Apelle river valley and in other parts of the zone. Poplar and Oak are the chief trees of the bluffs, and the herbaceous vegetation, as might be expected, is made up of a mixture of prairie and woodland forms.

The greater part of the second prairie steppe is true prairie, where no trees are met with except in the river valleys. Shrubs occur, generally forming low thickets or copses, and very frequently small clumps composed of a single species. On the exposed prairie their growth is always stunted. Snowberry (*Symphoricarpus occidentalis*), Silver berry (*Elæagnus argentea*), Buffalo berry (*Shepherdia argentea*), Saskatoon berry (*Amelanchier*) and Roses of which there are several species, are the most important. In damper situations, Meadow Sweet (*Spiræa salicifolia*) occurs, and in wet places, such as borders of ponds and marshes, willows are abundant. The herbaceous vegetation varies somewhat with soil con-

ditions. The following species may, however, be mentioned as representing the typical prairie flora[1]: *Stipa viridula, Spartina gracilis, Avena Hookeri, Poa crocata, Calamovilfa longifolia, Elymus Macounii, Agropyrum Smithii, A. tenerum, A. Richardsonii,* many species of *Carex, Allium cernuum, Lilium philadelphicum, Smilacina stellata, Rumex persicarioides, Lychnis Drummondii, Anemone hirsutissima, Ranunculus rhomboideus, Lesquerella argentea, Sisymbrium incisum, Cleome serrulata, Potentilla arguta, P. pennsylvanica, P. bipinnatifida, P. camporum, P. effusa, P. plattensis, P. pulcherrima, P. viridescens, Geum triflorum, Thermopsis rhombifolia, Astragalus caryocarpus, A. hypoglottis, A. adsurgens, A. bisulcatus, A. pectinatus, A. missouriensis, Psoralea esculenta, P. argentea, Glycyrrhiza lepidota, Petalostemum candidum, P. purpureum, Hedysarum boreale, Zizia cordata, Lomatium macrocarpum, Musineum divaricatum, Asclepias ovalifolia, Acerates virdiflora, Phlox Hoodii, Agastache Fœniculum, Physostegia parviflora, Monarda mollis, Pentstemon gracilis, Orthocarpus luteus, Lobelia spicata, Liatris scariosa, Grindelia squarrosa, Aster multiflorus, A. lævis, Erigeron glabellus, E. philadelphicus, Antennaria campestris, Ambrosia trifida, Lepachys columnaris, Helianthus rhomboideus, Helenium autumnale, Artemisia biennis, Senecio palustris, S. eremophilus, Cirsium undulatum, Agoseris glauca.*

Third Prairie Steppe.—This steppe includes the rest of the prairie up to the foothills of the Rocky Mountains. In its northern parts, *i.e.*, north of lat. 52,° the flora is very similar to that of the second prairie steppe. The southern part of the region, however, is of an altogether different type. The rivers and even creeks are flowing in deep narrow valleys, and the country in general is broken by coulees and low hills. The precipitation is scant, and, as a result, the vegetation is xerophile and often desert-like in character. Except on Wood Mountain and Cypress Hills no trees occur, unless along the borders of the streams in the valleys. The ponds, marshes and lakes are not even fringed with shrubs.

Large districts, especially in the Coteau de Missouri belt, are characterized by the absence of drainage valleys, the result being that the water in the lakes and ponds is generally saline, and that numerous alkali flats occur. The vegetation in such situations is very sparse and of course halophyte in character, the typical plants being *Distichlis spicata, Hordeum jubatum, Puccinellia airoides, Corispermum hyssopifolium, Atriplex* and *Chenopodium* species, *Salicornia prostrata, Suæda depressa, Salsola Kali, Rumex mexicanus, Ranunculus Cymbalaria, Plantago eriopoda, Heliotropium curassavicum, Pleurogyne fontana, Crepis runcinata.* In the saline ponds themselves, *Ruppia maritima* is common.

[1] For these and for other plants in the West only the Latin names are given, the reason being that the majority of the species characteristic of Western Canada have no generally recognized common names.

As mentioned above, the vegetation of the southern part of the third prairie steppe is decidedly xerophile. As a result, a number of species occur which approach desert types in being, in some way or other, protected against rapid transpiration. Such plants are: *Eriogonum flavum*, *Eurotia lanata*, *Opuntia polyacantha*, *Mamillaria vivipara*, *Potentilla Hippiana*, *Oxytropis splendens*, *Linum rigidum*, *Plantago Purshii*, *Aplopappus spinulosus*, *Artemisia frigida*, *A. cana*, *A. Ludoviciana*, *Senecio canus*, *Iva axillaris*, *Lygodesmia juncea*, and others.

Of other plants, characteristic of the southern part of the third prairie steppe, the following may be mentioned: *Bouteloua oligostachya*, *Munroa squarrosa*, *Schedonnardus paniculatus*, *Oryzopsis hymenoides*, *Stipa spartea*, *S. comata*, *Sporobolus Richardsonii*, *Calamagrostis americana*, *Danthonia intermedia*, *Agropyron dasystachyum*, *Zygadenus chloranthus*, *Rumex venosus*, *Oxybaphus hirsutus*, *Ranunculus cardiophyllus*, *Polanisia trachysperma*, *Chamærhodos erecta*, *Oxytropis Lambertii*, *Hedysarum Mackenzii*, *Potentilla flabelliformis*, *Heuchera hispida*, *Linum Lewisii*, *Malvastrum coccineum*, *Oenothera triloba*, *O. serrulata*, *O. pallida*, *Gaura coccinea*, *Solanum triflorum*, *Pentstemon acuminatus*, *P. procerus*, *Orobanche fasciculata*, *Liatris punctata*, *Gutierrezia Sarothræ*, *Chrysopsis villosa*, *Solidago missouriensis*, *S. rigida*, *Aplopappus lanceolata*, *A. acaulis*, *Townsendia exscapa*, *Aster angustus*, *Erigeron cæspitosus*, *E. pumilus*, *Antennaria aprica*, *Helianthus petiolaris*, *H. giganteus*, *Gaillardia aristata*, *Arnica pedunculata*, *Senecio integerrimus*, *Cirsium Drummondii*, *Lactuca pulchella*.

Rocky Mountain Foothills.—A great number of prairie species reach a considerable altitude in the foothills of the Rocky Mountains. On the other hand, a number of sub-alpine forms descend practically to the prairie, the result being that at the base of the foothills, where the two types of floras intermingle, the vegetation is very rich in species. As the foothills are ascended the prairie forms gradually disappear and are replaced by mountain species. The vegetation in general becomes more luxuriant in appearance, the herbaceous plants grow taller, shrubs begin to form an important feature in the flora and real forests are established. Besides typical mountain and prairie forms, the following species may be considered as characteristic of the foothills: *Stipa Richardsonii*, *Avena striata*, *Bromus Porteri*, *Elymus dasystachys*, *Eriogonum subalpinum*, *Arenaria capillaris*, *Aquilegia brevistyla*, *Delphinium glaucum*, *D. Menziesii*, *Thalictrum occidentale*, *Actæa arguta*, *Parnassia montanensis*, *Spiræa lucida*, *Oxytropis viscidulus*, *Hedysarum sulphurescens*, *Geranium Richardsonii*, *G. incisum*, *Epilobium latifolium*, *Angelica Dawsoni*, *A. Lyallii*, *Carum Gairdneri*, *Primula americana*, *Lappula floribunda*, *Castilleja* species, *Lonicera glaucescens*, *Aster con-*

spicuus, Erigeron speciosus, Artemisia discolor, Arnica foliosa, Senecio lugens.

Rocky Mountains Proper.—The lower parts of the mountains are covered with forest, composed chiefly of coniferous trees, viz.: *Pinus albicaulis, P. Murrayana, Pseudotsuga mucronata, Abies lasiocarpa.* In these woods, only a small number of shrubs occur, the most typical ones being *Pachystima Myrsinites, Rhododendron albiflorum, Menziesia ferruginea,* and, in open and springy places, *Salix commutata, S. Barclayi.* Except along the edges, in open spaces and along brooks and rivulets, the herbaceous vegetation of the Rocky Mountain forest is rather scant. The principal species typical of the forest are: *Clintonia uniflora, Corallorhiza* species, *Epipactis Menziesii, Rubus pedatus, Pyrola* species and other members of the ericaceous family.

On the grassy slopes above the tree-line the vegetation is very rich in species, exhibiting the general characteristics of alpine vegetation. As typical species may be mentioned: *Phleum alpinum, Calamagrostis purpurascens, Deschampsia atropurpurea, Poa paddensis, Poa Wheeleri* and other grasses, *Erythronium grandiflorum, Claytonia lanceolata, Caltha leptosepala, Aquilegia flavescens, Ranunculus Eschscholtzii, Leptarrhena amplexifolia, Parnassia fimbriata, Epilobium Hornemanni, Pedicularis bracteosa, P. racemosa, Valeriana Scouleri, Aster Engelmanni, Erigeron salsuginosus, Petasites frigida, Arnica latifolia, Senecio triangularis, Agoseris aurantiaca.*

Still higher up the apline flora is represented by a number of species of which the following ascend to the snow line: *Juncus Mertensianus, J. Parryi, Salix nivalis, Claytonia megarrhiza, Anemone occidentalis, Draba crassifolia, D. lonchocarpa, Smelowskia calycina, Physaria didymocarpa, Arabis Lyallii, Saxifraga cæspitosa, S. Lyallii, Potentilla glaucophylla, P. dissecta, Dryas* species, *Astragalus alpinus, Oxytropis inflatus, Viola orbiculata, Phyllodoce empetriformis, Cassiope Mertensiana, Gentiana glauca, Phacelia sericea, Myosotis alpestris, Castilleja pallida, Solidago ciliosa, Aplopappus Lyallii, Erigeron aureus, E. jucundus, E. multifidus, Antennaria lanata, A. racemosa, Saussurea densa, Crepis nana, Hieracium gracile.* Here also grow a number of species which have their homes in the Arctic zone, *e.g., Festuca ovina var. brevifolia, Carex rupestris, C. nardina, Kobresia Bellardii, Silene acaulis, Melandrium alpinum, Cerastium alpinum, Draba* species, *Cardamine bellidifolia, Potentilla nivea, Sibbaldia procumbens, Saxifraga oppositifolia, S. cernua, Arctostaphylos alpina, Androsace Chamæjasme.*

Selkirk Range.—The Selkirks differ in many respects from the Rockies. Whilst the latter may be characterized as a chain of isolated mountains, the Selkirk range has more the character of a high level plateau from which the peaks rise. For this reason there are, in the Selkirks,

real alpine meadows, whilst, in the Rockies, similar plant formations are generally met on steep slopes. With regard to the vegetation above the tree-line, it may be said that the differences between the two mountain systems are chiefly due to differences in moisture supply, the Selkirks being favoured with much more abundant precipation than are the Rockies. For this reason the alpine meadow associations of the Selkirks extend almost to the snow-line and, for the same reason, a number of the high alpine plants which, in the Rockies, are characteristic of the bare peaks above the grassy slopes, are not met with at all in the Selkirks.

The Selkirk forest differs from that of the Rocky Mountains with regard to composition as far as the trees are concerned, the principal species being *Thuja plicata*, *Pseudotsuga mucronata*, *Tsuga heterophylla*, *T. Mertensiana* and *Picea Englemanni*. The undergrowth is, on the mountains proper, very similar to that of the Rocky Mountains, and although much more luxuriant is not represented by many species.

In the lower valleys, however, and on lower levels, where the forest is more open in character, the shrubby as well as the herbaceous undergrowth is very different. Not only is it luxuriantly developed, but the species of which it is composed are of a different type. The Rocky Mountain flora is disappearing, its place being taken to such an extent by Pacific coast species that the traveller, or the casual observer, will find it rather difficult to detect any marked differences between the flora of the Selkirk valleys and that of the coniferous forest of the Pacific coast.

The Coast Range.—Biologically, the mountains of the Coast range are very similar to those of the Selkirk range. This is to a certain extent also true from a systematic standpoint, as practically all species found in the Selkirks also occur in the Coast range.

The Coast range, however, although having the bulk of plant species in common with the Selkirks, may be considered a distinct botanical province. The reasons for this are that many species occur which are confined to the coast proper and that the Coast range is the home of a number of what may be considered truly endemic plants, which, as far as is known at present, are very local in their distribution and are found nowhere else in British Columbia. Among those plants may be mentioned especially numerous species of *Antennaria*, *Arnica*, *Senecio*, *Aster*, *Erigeron* and other composites.

Owing to the long growing season, the high average temperature and the abundance of the precipitation, the vegetation in the valleys and the lowlands of the Coast range is almost subtropical in appearance. The trees, especially *Thuja*, *Picea* and *Pseudotsuga*, reach gigantic dimensions, and the forest, no matter how dense, always possesses a very luxuriant undergrowth. In old untouched forests, fallen trunks,

shrubs and herbs form an almost impenetrable tangle. This is especially true where Salal (*Gaultheria Shallon*) or Devil's Club (*Fatsia horrida*) are luxuriantly developed.

Of trees characteristic of the valleys and the lowlands may be mentioned: *Picea sitchensis*, *Alnus oregona*, *Acer macrophyllum*, *A. circinnatum*, *Rhamnus Purshiana*, and of shrubs: *Salix lasiandra*, *S. sitchensis*, *S. Scouleriana*, *S. Hookeriana*, *Berberis Aquifolium*, *Ribes Lobbii*, *R. bracteosum*, *R. sanguineum*, *Rubus spectabilis*, *R. parviflorus*, *Rosa* species, *Prunus* species, *Amelanchier florida*, *Osmaronia cerasiformis*, *Pyrus diversifolia*, *Fatsia horrida*, *Gaultheria Shallon*, *Vaccinium parvifolium*, *V. ovalifolium*, *Sambucus callicarpa*. Although here classed as shrubs, *Prunus*, *Pyrus*, *Amelanchier* and the willows often become trees near the coast.

The herbaceous vegetation is very richly developed. Of the great number of species characteristic of the region may be mentioned: *Adianthum pedatum*, *Lomaria spicant*, *Asplenium cyclosorum*, *Polystichum munitum*, *Aspidium dilatatum*, *Equisetum Telmateja*, *Agrostis exarata*, *A. microphylla*, *Trisetum canescens*, *T. cernuum*, *Deschampsia elongata*, *Poa Howellii*, *Glyceria pauciflora*, *Bromus*, *Fescuta* and *Elymus* species, *Carex cryptocarpa*, *C. dives*, *C. magnifica*, *C. macrocephala*, *C. Mertensii*, *Lysichiton camtschatcense*, *Fritillaria lanceolata*, *F. camtschatcensis*, *Erythronium giganteum*, *Maianthemum dilatatum*, *Trillium ovatum*, *Asarum caudatum*, *Nymphœa polysepala*, *Trauvetteria grandis*, *Ranunculus occidentalis*, *Coptis asplenifolia*, *Achlys triphylla*, *Dicentra formosa*, *Tiarella unifoliata*, *T. trifoliata*, *Tellima grandiflora*, *Leptaxis Menziesii*, *Aruncus acuminatus*, *Oenanthe sarmentosa*, *Stachys ciliata*.

Vancouver Island.—The interior and also the west coast of Vancouver island present, in general, the same botanical features as those characteristic of the Coast range just described. The southeastern part of the Island, however, is of a quite different botanical type. Here the growth is influenced by the comparatively small amount of precipitation and, as a result, the flora is ecologically more or less of a "dry belt" type. In addition, it is characterized by a number of species which belong to the Californian flora and occur nowhere else in Canada. Among the plants characteristic of the southeastern part of Vancouver Island may be mentioned: *Hookera hyacinthina*, *Camassia Leichtlinii*, *Olsynium grandiflorum*, *Hydastylus borealis*, *Quercus Garryana*, *Dentaria macrocarpa*, *Thysanocarpus curvipes*, *Lupinus* and *Trifolium* species, *Sidalcea Hendersonii*, *Opuntia polyacantha var. borealis*, *Godetia caurina*, *Boisduvalia densiflora*, *Gilia* species, *Scrophularia californica*, *Castilleja levisecta* and numerous others.

Dry Belts of British Columbia.—A few words may be said about the most important dry belts of British Columbia, including the Okanagan

and the Kamloops districts. These regions, owing to the scant precipitation and to the nature of the soil, have a flora which strangely contrasts with that of the other parts of the British Columbia mainland.

In the dry belts two floristic subdivisions may be recognized, which, however, run more or less into each other and, for this reason, will not be dealt with separately. The one subdivision is characterized by so called bunch grasses, of which *Agropyrum spicatum* and *Elymus condensatus* are the most prominent species, and is more or less destitute of forest forming trees. The other floristic subdivision of the dry belts is more densely wooded, the characteristic tree of the forest being the Yellow Pine (*Pinus ponderosa*). On the whole, the dry belt may be said to be parklike in general character.

Besides the above mentioned plants the following may be noted: *Eriogonum niveum, E. heracleoides, Atriplex argentea, Thelypodium laciniatum, Lesquerella Douglasii, Ribes cereum, Kuntzia tridentata, Astragalus collinus, A. convallarius, A. Purshii, Sphæralcea Munroana, Mentzelia albicaulis, M. lævicaulis, M. integrifolia, Oenothera pallida, O. andina, Phlox longifolia, Gilia aggregata, G. Harknessii, G. pungens, Collomia grandiflora, C. linearis, Pectocarya penicillata, Senecio Thomsoniensis, Erigeron concinnus, E. filifolius, Chænactis Douglasii, Chrysothamnus nauseosus, C. puberulus, Artemisia trifida, A. tridentata.*

CONCLUSION.

While it is impossible in a few pages more than to outline briefly the general characteristics of the flora of so large a country as Canada —a flora represented by nearly 5,000 well defined species and varieties of flowering plants—the enumeration of species representative of the different zones will, it is hoped, serve to give a fair idea of the flora as a whole and help a botanist unfamiliar with a particular region to determine what he may find there. Although there is a large and growing number of local botanists in Canada the general flora of the country is known to few but professional botanists, and it is chiefly for the information of the former class, and for those who do not reside in Canada, that this article has been written.

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